Using Multiple Data Sources, Including Multi-Seasonal Satellite Images, to Develop Habitat Maps for Ecological Risk Assessment at a Nuclear Facility

John E. Pinder III,[1] Kristy K. Guy,[2] Tracy E. Rea,[3] Deno J. Karapatakis,[4] Helen Wiggins-Brown [5]
[1] Colorado State University, CO
[2] US Geological Survey, FL
[3] Bechtel Savannah River, Inc., SC
[4] Savannah River Ecology Laboratory, SC
[5] University of Georgia, GA

Goal and Scope. Although most of the U.S. Department of Energy's 89,000 ha Savannah River Site (SRS) in South Carolina is in managed pine plantations and natural forests, almost 10% of the land has been used for the production of nuclear materials for weapons, medical procedures and space exploration. As part of the shutdown and clean up of facilities the site, is performing environmental and ecological risk assessments of all waste sites. The initial ecological assessments indicated the need for a more detailed habitat map of the site. Existing habitat maps based on remote sensing analyses of satellite images did not contain sufficient information on plant species present. U.S. Forest Service (USFS) maps of forest stands contained information on major tree species but did not contain sufficient detail about small habitat inclusions around vernal ponds and old roads, fence lines and house sites that existed when the site was established in 1951. This project was initiated to produce a more detailed habitat map by merging the existing USFS databases on forest types and conditions with a remote sensing analysis of recent satellite imagery.

Methods. Data from the Landsat Thematic Mapper (TM) satellite at three different times in 1997 were analyzed by remote sensing techniques to map the SRS at a greater spatial resolution than the more general USFS map. Although data from each time had a primary purpose, the classification procedure was based upon comparisons of the individual classes applied at each time. The resulting classification of spectral data was merged with USFS geographic information system (GIS) data that included 30 different forest types as well as information on tree sizes.

Results and Conclusions. The final habitat map exists in a number of digital forms, including ArcView Grid format, and is used to support ecological risk assessments of SRS waste sites. These waste sites may range from < 10 square meters to > 10 ha. As each site is identified and evaluated, the map is used to summarize the types and relative distributions of habitats in the appropriate surrounding area. This information is used to decide which animal species are likely to be present and possibly be at risk for exposure to the waste. The biology, behavior and susceptibility of these animal species are then evaluated.

Recommendations and Outlook. The procedure linking the habitat map to the animal species selected is largely a manual procedure, but work is continuing to build species-specific habitat models that will analyze the distributions of habitats and estimate a probability of occurrence for a number of common, threatened and endangered species at the SRS. This model building effort is based on the results of over 2000 published articles on the biology and ecology of the SRS. Habitat distributions on the SRS are not static. In particular, the USFS management of the pine forests includes numerous forest cuttings and forest replantings each year. These activities, especially the forest cuttings, result in significant changes in habitat suitability for and utilization by animal species. For this reason, regular revisions of the habitat map are being implemented using change detection procedures on more recent satellite images.